1. EXECUTIVE SUMMARY

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A reef restoration feasibility study was conducted for the Acadiana Bays area by a team of engineering and surveying firms working with the Louisiana Department of Natural Resources. This study had been requested for a number of years by advocacy groups most notably by the Acadiana Bays Association. The study described in this document was in some ways a repeat of a study done by the U. S. Army, Corps of Engineers, several years ago; however, that study report was never officially issued by the Corps. The primary goal of this project was to evaluate whether the anecdotal historical conditions of a productive, brackish water estuary could be reproduced by the introduction of reef structures within the Acadiana Bays area. While that goal was the primary driver of the project, it should be noted that there were other interests in the area which did not share that same goal. Notably the agricultural industry, namely rice farmers, did not wish to see a return to brackish conditions as they had adapted to the use of area waterways for rice irrigation.

The technical team that conducted this study was managed by the New Orleans, Louisiana firm Waldemar S. Nelson & Co., Inc. which also performed the preliminary engineering evaluation of alternative reef structures. Surveying, both bathymetric and topographic, was performed by John Chance Land Surveys, Inc, of Lafayette, Louisiana. An extensive mathematical modeling program was conducted to evaluate hydrodynamics and water quality parameters. This program was performed by Taylor Engineering, Inc. of Jacksonville, Florida. The geotechnical evaluation was conducted by Lourie Consultants of Metairie, Louisiana. The LSU Coastal Studies Institute's activities, managed by Dr. Greg Stone, consisted of placement of a marine and meteorological gage package which monitored water level, current, wave conditions and meteorological parameters. This station was operated for a period of 4 months, and the data were used in the modeling exercises.

The majority of the effort in this project phase was dedicated toward the modeling program. This decision was made early in the project planning and was based on the premise that the first objective of this project phase should be to determine whether the ultimate project goals and objectives could be met with placement of reef-like structures

in the bay areas. The primary goal and objective of the overall project was to determine if structure placement in the bays, given current hydrodynamics of fresh water flows in the area, could significantly influence the present salinity and turbidity conditions in the western bays with an aim toward approaching the historical, brackish conditions. In order to properly evaluate the changes in conditions in the bay system due to re-establishment of reef structures, it was necessary to obtain current bathymetric data. That effort was accomplished, and the project team developed a series of mathematical models which allowed assessment of changes to the hydrologic and water quality regime of the bays. The project team felt that the models developed to simulate changes in conditions due to reef placement were adequate for that use given the close comparison of model predictions with measured existing conditions during the models' validation phase. The following summarizes the results of the overall study.

Initially, two reef alignments with two sub-alternates were evaluated. One alignment (Reef A) was proposed by the Acadiana Bays Association. Reef A originated at Point Chevreuil and extended approximately 13 miles in a southwesterly direction (225 degree heading). The second alignment (Reef B) was oriented in an east-west direction and connected Point Chevreuil and Marsh Island. The sub-alternates of each of these alignments were different elevations of the crest of the reef structure (-3 ft mean low water [MLW] and mean high water [MHW], sub-alternates 1 and 2, respectively). Later in the study a third principal alternate alignment was added – a reef extending from Point Chevreuil due south (Reef C). Also, sub-alternates were added to each of the three principal alignments, those being segmented reefs which were thought to more closely represent the actual structure which may be built.

During the modeling phase the prevalent muddy bottom conditions in the bays were found to cause significant dampening of waves; this process had to be accounted for in the wave propagation modeling. Of the two initial alternative reef top elevations (-3 ft MLW and MHW), the lower reef elevation did not noticeably affect existing conditions of salinity and turbidity regardless of reef alignment. This finding influenced the decision to only model the higher crest elevation for the third alignment (C).

A complete blockage of flows from the Lower Atchafalaya River and Wax Lake Outlet into the western bays (reference reef alignment B) does not significantly increase salinity levels in the western bays as it also significantly cuts off salt water input from the Gulf. Turbidity levels are reduced in the western bays with this alignment particularly during high and intermediate flows in the Lower Atchafalaya River and Wax Lake Outlet. Reef alignment A does exhibit a more substantial change in salinity levels in the Cote Blanche Bays compared to alignment B for the mean fresh water flow conditions evaluated. This alignment allows salt water from the Gulf to enter the western bays. This effect on salinity level (concentration) increase is limited to two to three parts per thousand. Turbidity levels are also reduced in the western bays with alignment A but not as significantly as with alignment B. Alignment C-3, a segmented reef extending due south from Point Chevreuil, was also found to have relatively minimal effect on salinities in the bay systems although the effect was slightly more pronounced than a segmented alignment A reef.

Because the results of the reef modeling, particularly with respect to the minimal salinity increases predicted, did not match the anecdotal, historical accounts of the brackish nature of the estuary, other modeling runs were performed to try to mimic those historical conditions. Basically, the models were adjusted to reflect pre-1940 conditions. The input parameters for this additional modeling reduced fresh water flow into the system from such outlets as the Wax Lake Outlet, the Jaws, and the Gulf Intracoastal Waterway. Efforts were made to determine the flows into the system as they would have been in the pre-1940 period. These model runs indicated that the average salinities in the bay system could be as high as 10 parts per thousand for extended periods of time which could very well represent the historical conditions.

Reef alignment B exhibited the greatest effect on storm surges along the northern Acadiana Bays shorelines; however, the reduction in surge was only one-half foot. The C-3 alignment was not evaluated for effect on storm surge, but it would undoubtedly exhibit a smaller effect than either of the other alignments.

From a preliminary engineering perspective, given the assumptions that had to be made on poor soil strength of bay bottoms, the restoration of historical reefs in this area

would prove to be an expensive project. If the assumptions on soil strength prove to be correct, then a large cross section (bottom width) would be necessary to construct the reef. The reef would have to be reasonably well armored to prevent erosion due to increased currents; thus, an all-sand type structure would not be practical. This study did make an initial evaluation of alternative construction means which could improve soil strength leading to reduced cross sections. The approach of utilizing deep soil mixing to improve the foundation did provide significant savings to the estimated construction costs.

Estimated construction costs for the reef alternatives which crested at MHW ranged from just over $100 Million to almost $400 Million depending upon alternative alignment and type of construction. While the alternatives cresting at – 3 ft MLW were less expensive, these had minimal effect on water quality parameters of interest in this study. It would most likely be possible to reduce these estimated costs of reef construction if a more detailed surveying and geotechnical evaluation was performed specifically in the area of anticipated reef placement.

LDNR staff evaluated the changes in modeled salinity levels in the bay system to determine whether the relatively minor changes to salinity patterns could modify habitat conditions to a point where desirable marine species would re-establish concentrations in the area. This biological analysis focused on three species – spotted seatrout and white and brown shrimp. The conclusion in this assessment was that the minor changes in salinities would not appreciably improve the habitat suitability for spotted seatrout, but salinities under the historical conditions were much more suitable for spotted seatrout. Salinities were probably not limiting for either brown or white shrimp, so the predicted changes in salinities would likely not affect shrimp suitability.

There are much more detailed discussions of all of these individual studies and assessments in the subsequent sections of this report.